

WE CLAIM:

1. A plastic package for use in semiconductor devices,  
said package having a plurality of metallic terminals  
5 exposed on a package surface, comprising:  
    a metallic bump attached to each of said terminals,  
    said bumps made of reflowable metal and having  
    approximately uniform height; and  
    an adherent layer of polymer material covering said  
10 package surface and surrounding each of said  
    bumps to form a solid meniscus, said layer having  
    a thickness between a quarter and one half of  
    said bump height.
2. The package according to Claim 1 wherein said plastic  
15 is any polymeric material used in semiconductor  
encapsulation, including molding compounds as well as  
thermoset and thermoplastic formulations.
3. The package according to Claim 1 wherein said  
semiconductor devices include any product of the ball-  
20 grid array and chip-scale package families.
4. The package according to Claim 1 wherein said  
reflowable metal is selected from a group consisting of  
tin, indium, tin alloys including tin/indium,  
tin/silver, tin/bismuth, and tin/lead, conductive  
25 adhesives, and z-axis conductive materials.
5. The package according to Claim 1 wherein said bumps  
have a diameter from about 50 to 700  $\mu\text{m}$  and a center-  
to-center spacing between about 100 and 1300  $\mu\text{m}$ .
6. The package according to Claim 1 wherein said polymer  
30 material for said adherent layer includes non-  
electrically conductive adhesives, epoxies filled or  
unfilled with inorganic particulate fillers including

boron nitride or aluminum nitride, bisphenol A with an anhydride cross-linking agent, having a viscosity of < 8000 cps and an elasticity modulus between about 1 and 5 GPa.

5 7. A polymeric substrate for use in electronic assembly boards, said substrate having a plurality of metallic terminals exposed on a substrate surface, comprising:

a metallic bump attached to each of said terminals,  
said bumps made of reflowable metal and having  
10 approximately uniform height; and  
an adherent layer of polymer material covering said substrate surface and surrounding each of said bumps to form a solid meniscus, said layer having a thickness between a quarter and one half of  
15 said bump height.

8. The substrate according to Claim 7 wherein said assembly board is selected from a group consisting of organic materials, including FR-4, FR-5, and BT resin, with or without strengthening or thermally modulating  
20 fibers or fillers, including a grid of glass fibers.

9. A method for completing a polymer plastic package for use in semiconductor devices, comprising the steps of:

providing a polymer package having a plurality of metallic terminals exposed on a package surface,  
25 said terminals spaced apart;  
attaching a metallic bump to each of said terminals, said bumps made of reflowable metal and having approximately uniform mass and height;  
reflowing said bumps, while maintaining approximate  
30 uniformity of predetermined height;  
stencil-printing a water-soluble polymer to coat the top surface of said bumps;

positioning said packages in the vacuum chamber of a plasma apparatus so that said surface faces the plasma source;

initiating a plasma and controlling the ion mean free path so that said ions reach said surface with predetermined energy;

exposing said surface to said plasma for a length of time sufficient to

- roughen said polymer surface;
- clean said polymer surface from organic contamination; and
- improve the surface affinity to adhesion;

removing said package from said vacuum chamber;

distributing an adherent polymeric precursor between and around said bumps, to form a meniscus on each of said bumps and to fill said space between said bumps by a layer having a thickness between a quarter and one half of said height of said bumps;

supplying additional thermal energy for curing said polymeric precursor, whereby said layer and said meniscus solidify;

cooling the package to ambient temperature; and

washing said package in DI water to remove said

water-soluble polymeric bump coating, completing said plastic package.

10. The method according to Claim 9 wherein said water-soluble polymer is polyvinyl alcohol.

11. The method according to Claim 9 further comprising the process step of slightly polishing said bump surfaces before said step of washing to remove excess polymer.